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CONTRIBUTIONS FROM THE HARVARD MINERALOGICAL
MUSEUM.

VIII. — *PETROGRAPHICAL NOTES ON SOME ROCKS
FROM THE FIJI ISLANDS.*

BY ARTHUR S. EAKLE.

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A COLLECTION, consisting of specimens of volcanic rocks from the various islands of the Fiji group, collected by Mr. Alexander Agassiz during the winter of 1897-98, was kindly placed in the hands of the writer for a petrographical study. Each of the islands is, in general, represented by specimens from one locality only, since the purpose was to obtain simply an idea of the nature of the island rock, and not to obtain a complete petrographical knowledge of the islands. In the case of the very small islands, some of which are simply single exposed rocks, the specimens collected can be considered as representative, but with the majority of the islands structural and mineral differences may, and probably do, exist in the rocks from different localities. The description, therefore, of the specimen or specimens from each island, as given in this paper, cannot be offered as the representative petrography of the island.

The Fiji group comprises two large islands, Viti Levu or Great Fiji and Vanua Levu, together with a multitude of much smaller ones lying east, south, and west of Viti Levu. Many of these small islands were visited by Mr. Agassiz, and specimens from about twenty-five of them were collected.

In 1876 Th. Kleinschmidt visited some of these islands and collected specimens of the rocks for the Museum Godeffroy in Hamburg.* These specimens were later studied by Arthur Wichman,† and it is from his published results that we have gained the most of our present knowledge of the petrography of these islands.

* Journ. Museum Godeffroy, 1879, XIV. 264.

† Min. und petrog. Mitth., 1883, V. 1-60.

Viti Levu, besides being the largest and most important island of the group, possesses much more geological interest than the rest of the islands, since it is essentially different in its rock formations. Wichman has shown that granites, syenites, diorites, and gabbros occur on this island, as well as crystalline schists and limestones; and he reaches the conclusion that the island was an old continental mass composed of these older plutonic rocks which stood above the water during the whole of the Paleozoic and Mesozoic ages. During the Tertiary the island was submerged, and received its stratified deposits of limestone, sandstone, and conglomerate, and was also rent by volcanoes. A few specimens from the interior of the island were given to Mr. Agassiz, one of them being a small piece of dioritic granite having the typical hypidiomorphic granular structure, and thus tending to confirm the presence of plutonic rocks on the island.

The large island of Vanua Levu, which lies northeast of Viti Levu, is said to be similar to Viti Levu in structure, but very little is known about it. Kleinschmidt describes a visit to the hot springs on it, but apparently made no petrographical collections. The rest of the islands of the group are volcanic or of coral formation.

The various types of igneous rocks found in the collection might be conveniently included under the following heads:—

Dioritic granite.	Hypersthene andesite.
Augite andesite.	Hornblende andesite.
Augite-biotite andesite.	Basalt.
Augite-olivine andesite.	Olivine basalt.

Andesites and basalts are the characteristic rocks of the region, and they show the usual variations in structure and mineral components. Augite andesite seems to be the predominating rock of the islands, and it varies from types having a small amount of augite with a large amount of feldspar, with biotite as an accessory, to those in which augite is the dominant constituent, showing a gradation into a basalt. Hypersthene andesite was shown by one specimen, so it can be considered as of rare occurrence. Hornblende andesite is more common, yet is also very limited in amount compared to the augite andesite. In fact, the more basic type of the andesitic family predominates, augite, olivine, and labradorite forming the most abundant constituents of the specimens.

In the description which follows each island represented in the collection has its specimen or specimens described in detail.

VITI LEVU.

Specimens of eruptives were obtained by gift from three localities on this island.

Kai Vatu Lola.— Specimens of jasper, quartz, and the granite previously mentioned are labelled from this place, which is believed to be in the central part of the island.

The granite megascopically presents a white granular rock, having plates of dark hornblende well disseminated through it. The structure is hypidiomorphic granular, and the composition is essentially of plagioclase feldspar with green hornblende plates and quartz grains. Most of the feldspar sections exhibit fine polysynthetic twinning combined very often with Carlsbad twinning. The extinction angles on sections normal to the brachypinacoid 010 vary from a small angle up to a maximum extinction of 18° . The index of refraction of the sections showing the larger extinction angles is slightly below that of the Canada balsam, indicating albite as the feldspar, while oligoclase is also present, but not so prominent. A few sections of orthoclase more cloudy in appearance than the plagioclases occur, and also two or three sections of microcline showing a beautiful grating structure. The feldspars are in general quite fresh and free from inclusions with the exception of an occasional apatite and zircon crystal. A few of the smaller sections possess good crystal boundaries.

Hornblende is abundant in plates with ends usually frayed out. Much of it is altered to yellowish green chlorite and granular epidote and the formation of some calcite. The fresh hornblende shows strong pleochroism.

Quartz is not very abundant in the rock, and cannot be detected in the hand specimen. A few basal and prismatic anhedral grains are seen however in the thin section as an original filling between the feldspars. Magnetite occurs which is evidently titaniferous, as it usually has a border of grayish leucoxene surrounding the grains.

An analysis of this rock would doubtless show a large percentage of soda in its composition because of the large amount of albite present, as well as of oligoclase, and the small amount of potash feldspar. While designated here as a dioritic granite, it might perhaps equally well be considered a quartz diorite. It is the only one of the specimens in the collection which is not effusive in its origin. Wichman describes an amphibole granite very rich in plagioclase from Muanivatu Mountains*

* *Loc. cit.*, p. 8.

in the island, which agrees quite closely with this rock, and may possibly be the same rock.

Mt. Victoria. — A specimen of augite andesite is from this mountain, which rises in the northern part of the island. The rock shows megascopic prisms of augite, magnetite grains, and a few feldspars in a dense greenish black base. Under the microscope the groundmass appears as a web of feldspar and augite microlites with many magnetite grains, cemented by a colorless to yellowish glass, the whole having a hyalopilitic structure.

Plagioclase, augite, and anhedral magnetite occur as phenocrysts. The feldspar phenocrysts predominate. The sections are large twinned plates and give an average extinction of 28° normal to 010, showing them to be labradorite. Zonal structure is seen well in some of the brachypinacoidal sections, and the extinction angles of the zones range from $+7^\circ$ on the outer shell to -39° in the centre. Colorless and yellowish glass inclusions are abundant in the feldspar phenocrysts in zonal arrangement. Augite or diopside occurs in pale green, large basal and prismatic sections occasionally containing inclusions of glass and magnetite with a few apatite needles.

The feldspar and augite phenocrysts have been penetrated along the cleavages and fissures by a yellowish brown oxide of iron which also lines some of the cavities with brown banded layers. This oxide has apparently been derived from an iron-rich olivine, whose former presence is indicated by a few irregular sections of fibrous serpentine mixed with brown iron oxide and carbonates.

The base of the rock weathers to a light brown, leaving the augite crystals standing out prominently unaltered.

Na dari Vatu. — An olivine-bearing augite andesite is labelled from this locality, which is said to be in the northern part of the island.

The rock has a dark gray holocrystalline base in which megascopic crystals of black augite are prominently disseminated. The base is largely feldspathic, but includes some small augites, although most of the pyroxenic constituent of the rock is in large phenocrysts.

Plagioclase, augite, and olivine are the chief constituents.

Sections normal to 010 of the feldspars give an average extinction of 22° , indicating an andesine or perhaps the soda-lime end of labradorite, as the kind of plagioclase phenocrysts. Zonal structure is common, and inclusions of the older formed minerals augite, olivine, and apatite, besides much glass, zonally arranged, are seen.

Augite occurs in automorphic sections, containing apatite and olivine inclusions. It is subordinate to the feldspars in amount.

Olivine is present in large and small irregular grains, but is not abundant. A slight serpentinization has taken place along some of the fissures.

Small grains of magnetite occur.

Besides these eruptive rocks just described from Viti Levu, a few specimens of sedimentary formation were collected from along the southern shore of the island. One of them is a coarse conglomerate, which forms a bluff near Suva. It consists of large rounded pebbles and fragments of rock, apparently decomposed andesite, cemented by a very impure calcareous cement. A specimen of a compact white limestone, somewhat siliceous and stained slightly yellowish by iron oxide was collected from a locality twenty-five miles up the Singatoka River.

Specimens were also brought from the two very small islands, Viwa and Mbau, which are close to the eastern coast of Viti Levu. From Viwa is a dark gray compact fossiliferous limestone, and from Mbau a brown decomposed mass termed "soapstone," apparently a sedimentary deposit from an altered eruptive rock.

AUGITE-BIOTITE ANDESITE FROM NA SOLO.

The Solo rock on which the lighthouse stands rises just above the water in the centre of the lagoon formed by the North Astrolabe coral reef. Several specimens of this rock were collected, but no differences are seen in any of them.

The rock has a very fine holocrystalline structure with no porphyritic tendency apparent in the hand specimen. It is light ash gray in color, sprinkled with small dark augite crystals.

Microscopically, however, the rock, while not possessing a prominent porphyritic structure, does show many small idiomorphic phenocrysts in a distinctly finer feldspathic base. The feldspars are characterized by isometric forms and zonal structure. Extinctions on the successive zonal layers show a passage from an acid rim to a very basic centre, the maximum extinction in the centres being 35° . The extinction angles of the laths vary from 0° to 20° , the majority being low and indicating oligoclase as the chief feldspar. The Carlsbad and albite twinning are common.

Augite or diopside is well disseminated in the rock as very pale green rounded crystals and fragments. They have all lost their original boundaries, and some have altered to calcite.

Biotite occurs in small brown plates, but is not abundant. It is only

seen in the more acid varieties of the andesites, and therefore appears in but two or three of the rocks from this region. Magnetite is common as fine dust particles and occasionally as anhedral. A few apatite prisms occur in the feldspars.

HORNBLENDE-ANDESITE FROM KANDAVU.

Kandavu is an irregularly shaped island, stretching northeast to southwest about thirty-two miles long and quite variable in width, lying south of Viti Levu. It is of volcanic origin and has several elevated peaks, that of Mbuke Levu or Mt. Washington, 2,750 feet, being the highest.

Specimens from this mountain are light gray in color, and have phenocrysts of feldspar and hornblende distinctly visible in a glassy base.

Under the microscope the groundmass is seen to be a thick filz of feldspar rods with much magnetite in grains, in a colorless glass, the structure being hyalopilitic. The phenocrysts are mainly plagioclase and hornblende.

The feldspar phenocrysts occur in automorphic plates with a zonal structure. The extinctions of these zonal layers show also a passage from acid rims to basic centres. The small rods of feldspar in the groundmass usually extinguish under 5° , making oligoclase the main feldspar. A few of the large plates contain glass and gas inclusions.

Hornblende is present in yellowish green to deep green pleochroic basal and prismatic sections, having perfect boundaries. Some of the plates are twinned on the orthopinacoid and some show resorption borders. Stout apatites are included. A little calcite has been formed from the alteration of the hornblende.

Biotite is seen in one or two flakes only, showing that it is a rare accessory. A few grains of very pale green, almost colorless pyroxene also occur, probably a diopside; a few anhedral of magnetite and some basal and prismatic sections of apatite constitute a part of the accessories.

A specimen collected from the John Wesley bluff, which is on the north shore of the southern half of the island, near Tavukie, is an andesitic tuff, showing remains of hornblende crystals whose contents have been altered to chlorite and calcite with a separation of magnetite, embedded in a dusty amorphous base. Considerable tridymite has formed along the fractures in the rock and in cavities.

Kandavu is the only island of the group besides Viti Levu from which specimens were collected, which have been previously described by Wichman. A description of the hornblende andesite from Mt. Washington is given by him.

BASALT FROM MBENGHA.

Mbengha is a small island lying near the southern coast of Viti Levu.

The structure of the basalt is somewhat intersertal, consisting of stout laths of feldspar with the interspaces filled with a mixture of glass and magnetite grains and some augite microlites.

The feldspar phenocrysts show labradoritic extinctions, and are generally cloudy from numberless brownish glass inclusions and dust particles zonally arranged. The centres of the sections are mostly quite dark with these inclusions, while the rims are pure and colorless.

Augite occurs abundantly as the largest phenocrysts. It is of the common pale green color, non-pleochroic, and occurs in very perfect idiomorphic crystals. They show a well developed cleavage, and often a zonal and also a beautiful hourglass structure. The orthopinacoidal twinning is seen on some of the plates. Large well formed crystals of apatite are present. Yellowish brown stains of iron oxides traverse the groundmass and line the cavities with banded layers.

Specimens were collected from a few of the small islands lying directly west of Viti Levu which appear to belong to the more acidic end of the andesitic group of rocks.

ANDESITE FROM MALOLO.

Malolo is a small low island lying near the west coast of Viti Levu.

The rock from this island is compact, holocrystalline, and of a lead gray color. It has a feebly polarizing feldspathic base in which frayed out rods of feldspar occur, giving the rock a trachytic appearance. The small laths of feldspar show less than 5° extinction angles. A few small patches of chlorite in bright green plates occur. The specimen is from the surface, and appears as if it had been exposed to the action of the waves, by which its original condition has been changed into a felsitic appearing rock. Magnetite is present in grains.

ANDESITE FROM VATU MBULO.

Vatu Mbulo is a mere projecting rock above the water, belonging to the Malolo group. In appearance the specimen from this island is very much the same as the preceding. It has the same compact felsitic appearance, with a lead gray color, and seems also to have been altered by the constant exposure to the waves. Under the microscope, however, it shows a few phenocrysts in the base. The groundmass is a mixture of

alotriomorphic feldspar and quartz grains, while both plagioclase and quartz appear as phenocrysts in this microcrystalline base.

An extinction angle normal to the albitic twinning was 20° on the best section. Some of the sections show no polysynthetic twinning, and resemble glassy sanidine with Carlsbad twinning common.

Quartz occurs as an original constituent in large crystals with rounded edges. They contain inclusions of glass and liquid. Some of the sections have a wide resorption rim.

Some of the feldspar has altered to calcite. Magnetite dust is plentiful. There are some areas of yellowish green material which seem to be mixtures of chloritic substance with carbonates, which may have resulted from the alteration of some ferromagnesian mineral, but further than this there is no indication of a dark silicate present.

The rock is perhaps more a dacite than an andesite, but from its present condition little can be learned regarding its former nature.

HORNBLENDE ANDESITE FROM WAIA.

Waia is a small island three and a half miles long by about three miles wide, lying thirty miles west of Viti Levu. It is one of the most southern of a train of volcanic islands belonging to the Yasawa group, and has several high peaks, one rising 1,870 feet above the sea level.

The specimen from this island is a hornblende andesite having a lead gray color and compact texture. Small glassy feldspars can be detected in the groundmass.

The base lacks glass, and appears microfelsitic with some microlites, and many allotriomorphic grains, of feldspar. Plagioclase phenocrysts occur, having an average extinction on sections normal to 010 of 21° . Polysynthetic and Carlsbad twinning are common. Many of the sections show the zonal structure. Some calcite has been developed from the alteration of the feldspar. Well defined basal and prismatic outlines of hornblende crystals are shown by magnetite, but the original hornblende has completely altered, yielding a mixture of chlorite with calcite.

Pyroxene was also a constituent of the rock, although not so abundant as the hornblende. One crystal, presumably diopside, is seen which has completely altered to calcite.

Magnetite occurs abundantly in fine dust and occasionally in good-sized anhedral forms.

This rock is probably the same as the hornblende andesite from Kandavu, but is in a more advanced stage of alteration.

HYPERSTHENE ANDESITE FROM VOMO LAI LAI.

Vomo lai lai is a rock about two hundred feet high on the island of Vomo, which lies near Waia.

The specimen is a gray porous rock having visible small phenocrysts of pyroxene and feldspar.

The groundmass has a hyalopilitic structure consisting of a dense mat of feldspar rods and augite microlites with magnetite grains cemented by a greenish brown glass. The amount of base is small compared with the phenocryst constituent of the rock.

The pyroxene microlites appear to be wholly augite, as they are non-pleochroic and do not extinguish parallel. The phenocrysts are plagioclase, hypersthene, and augite.

The plagioclase phenocrysts predominate, and most are short rectangular sections and square plates, abundantly filled with zonally arranged brownish glass inclusions which impart a cloudy aspect to the sections. Undulating extinction due to pressure or strain is noticeable in several of the larger plates. The extinction angles on sections normal to the twinning lamellæ reach 33° , showing the presence of a quite basic labradorite. The rods, however, and some of the phenocrysts, show much smaller extinction angles, under 10° , and are probably oligoclase.

The pyroxene phenocrysts are both hypersthene and augite, which are at times intimately associated. The hypersthene occurs in prismatic and basal sections which give the common optical characteristics. The pleochroism is quite marked, although not especially strong; c = bluish green, a = reddish brown, and b = brownish yellow. The plane of the optic axes is 010, and sections parallel to 100 show they are normal to the acute bisectrix, although the optic angle is a little wider than the field of the microscope. The augite is bluish green, exactly matching the color of the hypersthene in the vertical direction. It is non-pleochroic and shows the large extinction angle. One section encloses an irregular core of the pleochroic hypersthene.

This is the only instance where the orthorhombic pyroxene was noted as a constituent of the rocks from this region, yet its presence might be more generally shown from a study of a larger amount of material. There is a noticeable absence of olivine in the rocks of these islands, while on the other hand it is a common constituent of the rocks from all of the volcanic islands lying at a distance to the east of Viti Levu. These eastern islands are composed of rocks decidedly more basic in composition than those from the islands immediately adjacent to the large island of Viti Levu, as will be seen in the descriptions which follow.

OVALAU.

This is a very important island of the group, lying just east and near Viti Levu, but no specimens other than some much decomposed rock from the vicinity of Levuka were collected. The specimens appear to be altered andesites, either hornblende or augite andesites. According to Wichman the prevailing rock is augite andesite, although some hornblende andesite does occur.

OLIVINE BASALT FROM WAKAYA.

Wakaya is about four miles long, lying nine miles east of Levuka. Its highest peak rises 595 feet above the sea.

The basalt is a dark greenish brown vesicular rock containing amygdaloids of calcite.

Microscopically the rock shows a brown vitrophyric base which has a slight tendency to perlitic structure developed in the consolidation. Long, slim feathery forms of feldspar are scattered through the amorphous base. There are only one or two lath-shaped sections present, and these show by their extinctions that they are labradorite. The phenocrysts are olivine and augite. Olivine occurs in perfect automorphic crystals which are often stained yellowish by the oxide of iron which has resulted from a slight alteration of the olivine. Embayments formed by the groundmass are seen in some of the crystals.

Augite is less than the olivine in amount. It occurs in pale green automorphic crystals, and contains inclusions of the older minerals, olivine and magnetite, besides some glass.

The rock from its mineral composition might be considered a limburgite, yet the large amount of glass base present would doubtless show the rock to be, chemically, a more acidic type of rock than a limburgite.

OLIVINE BASALT FROM MAKONGAI.

Makongai is two miles long by one and a half miles wide, lying seven and a half northwest of Wakaya. It has two peaks in the centre, with an average height of 875 feet.

The specimens from this island are too much altered to determine their petrographic characters, but the rock appears to have been like that from Wakaya. Well developed olivine and augite crystals are still preserved in the decomposed base.

OLIVINE BASALT FROM NGAU.

The island of Ngau lies twenty-seven miles southeast of Ovalau, and is eleven miles long by four miles wide.

The rock is porous, of a gray color, and under the microscope shows a base composed mainly of stout plagioclase laths, whose angular interspaces are filled with a speckled mixture of bluish green augite microlites, minute feldspathic rods, and magnetite grains, the whole forming an intersertal structure. No glass is however apparent. The feldspathic constituent is limited to the plagioclase laths and rods in the groundmass, and is subordinate to the pyroxene in amount. Albitic twinning combined with the Carlsbad is common, and the extinction angles on sections normal to the twinning planes are those of labradorite, averaging 28° . Most of the phenocrysts are large automorphic augites, the olivine being subordinate in amount and size.

Augite occurs in light green perfect crystals, some of which show a very weak pleochroism to yellowish tones. Zonal structure and twinning is seen in several of the sections. Inclusions of olivine and magnetite are present and some of the sections have been penetrated along the cleavage by the groundmass. Olivine occurs here and there in the slide in rounded grains without any original crystal boundaries, and most of it has altered slightly so as to be coated yellowish brown.

A few anhedral magnetite occur, but most of the magnetite is in small grains.

AUGITE ANDESITE FROM NAIRAI.

Nairai Island is four miles long by one and a half to three miles wide, lying about ten miles east of Ngau.

The rock has a hyalopilitic base, consisting of minute short rods of feldspar with augite grains and magnetite particles in a glass cement. The feldspar phenocrysts which were present have all been altered to a brown carbonate, leaving only the rims of the original mineral. The brown carbonate is apparently calcite stained with the iron oxides, this staining solution saturating a good portion of the groundmass and filling the cavities with banded walls of brownish opalitic material.

Augite occurs in automorphic crystals, which occasionally show twinning parallel to the orthopinacoid. A few grains of olivine can be detected stained reddish brown.

Na Kobu. — This is a peak in a small island of the Nairai group, just off the south coast of the main island.

Specimens of augite andesite were collected from the top and base of the Kobu which show only a slight structural difference. The rock from the top is dark gray and fine-grained. It shows under the microscope a groundmass having a hyalopilitic structure. Feldspathic rods, green augite microlites, and magnetite grains are thickly strewn in a glass base. Some of the feldspars reach dimensions to be called phenocrysts, but in general the porphyritic character of the rock is not marked. The feldspar rods have a distinct parallel flow arrangement.

The pyroxene constituent is only in microlitic form, no phenocrysts occurring.

The specimen from the base of the Kobu is of the same nature as that from the top, but it shows a distinct porphyritic structure, having numerous large phenocrysts of feldspar.

AUGITE-OLIVINE ANDESITE FROM MOALO.

Moalo is a triangular shaped island seven miles long by five miles wide, lying southeast of Viti Levu. The specimen was collected from the Observatory Rocks on the northern coast.

The rock is dark gray, compact, and shows megascopic crystals of augite and olivine in the base.

Microscopically the groundmass has a pilotaxitic structure, and consists of minute uniform-sized crystals of augite and feldspar in distinct flow arrangement, sprinkled with grains of magnetite and some brown grains of olivine.

The groundmass forms the larger part of the rock, and the phenocrysts are mostly augite and olivine.

The few plagioclase phenocrysts give labradoritic extinctions, averaging 27° on sections normal to 010.

The phenocrysts of augite and of olivine are large, the latter predominating in number.

Augite is in good automorphic sections, and contains inclusions of the older olivine. The olivine sections usually have a yellowish brown border enclosing the colorless centres, and the iron oxide has also penetrated along the fractures.

OLIVINE BASALT FROM TOTOYA.

Totoya is a circular island about six miles in diameter, being an extinct volcano with a crater bowl three miles in diameter and a ridge 1,200 feet above the sea. It lies a few miles southeast of Moalo. Specimens

were collected from the top of the ridge, and from the interior of the bowl.

The specimen from the top of the ridge is somewhat decomposed, but resembles the basalt from Wakaya.

The groundmass has a pilotaxitic structure consisting of rather long parallel arranged laths of feldspar and a speckled mixture of augite and feldspar microlites with magnetite and olivine grains. The phenocrysts are labradorite, augite, and olivine.

The rock contains very few large sections of feldspar, most of this constituent appearing as slender laths in the groundmass.

Augite occurs in very large pale green crystals, which are usually much broken up and of irregular form. Zonal structure is well shown. Some of the sections contain areas of rectangular-shaped glass inclusions. These are also seen in the larger feldspar sections.

Olivine is scattered throughout the rock in small corroded grains, with a few fragments of larger phenocrysts. It is all coated reddish brown. From the characteristic yellowish to reddish brown grains in many of these rocks, iddingsite is strongly suggested; yet the coloring matter is in general not homogeneous throughout the grain, the centres often being colorless and showing the high polarization colors of olivine.

Calcite fills several of the cavities as a secondary formation, and usually has a brown border from the presence of much iron oxide. This oxide of iron, which has apparently arisen through the alteration of the olivine, has filled many of the cavities with the same banded layers as previously noted.

The specimen from the interior of the crater has an orthophyric type of groundmass, and the rock is a basaltic lava.

Short rectangular and square sections of feldspar are numerous, between which is a dusty brown glass. No original dark silicate is present, but secondary serpentine is common and in many cases fills the cavities with light yellowish green radiating fibrous bands. Brown limonite is also a frequent filling for these cavities. Large areas of calcite and a few cavities having quartz in them occur.

OLIVINE ANDESITE FROM KAMBARA.

Kambara is the next island visited, just east of Totoya. It is one of the southern islands of the Lau or Eastern group, and is four and a half miles long by three miles broad.

The hand specimen shows a very fine dark gray holocrystalline rock, with no porphyritic structure apparent.

The groundmass under the microscope is seen to be composed of a filz of violet tinged augite microlites and feldspar laths, presenting a very homogeneous structure which can be designated as pilotaxitic. The small augite prisms have rounded ends, and seem fully equal in amount to the feldspar.

The rock lacks phenocrysts of any size. The only mineral present which is plainly of an older crystallization is olivine. This is well disseminated in the rock as small rounded sections whose original crystal boundaries have been lost by corrosion. These sections are not much larger than those of the groundmass. They have the common yellowish to yellowish brown color from the iron staining, and only a few show colorless centres.

A small flake of biotite, which is nearly colorless normal to and deep brown parallel to the polarizer, can be detected here and there in the groundmass.

AUGITE ANDESITE LAVA FROM KOMO.

Komo is another island of the Eastern group, lying northeast of Kambara. It is very small, one and a half miles long by half a mile wide. The specimen was collected from the shore bluff, and is a black vesicular rock.

The groundmass shows a multitude of short rectangular sections with a less number of augite grains in a brownish amorphous base which is quite dusty from magnetite grains. There is a considerable impregnation of this base by brownish limonitic stains, and the same banded filling of opal in the cavities is noted.

The phenocrysts are in the main large automorphic crystals of labradorite. Many have been corroded by the magma, and most are filled with dark glass inclusions. Some of the sections show alternate zones of clear and cloudy layers.

Augite occurs, but is much inferior to the feldspar in amount. One automorphic crystal has a pleochroic core, yellowish green to brown, which resembles hypersthene, but no other indication of hypersthene was seen in the slide.

OLIVINE ANDESITE FROM YANU YANU.

This is a very small island, two hundred feet high, of the Exploring Isles.

The specimen presents a dark gray compact holocrystalline rock. It lacks any definite porphyritic structure, although a few of its constituents

show a different period of crystallization from the groundmass, and reach a size to be designated as phenocrysts.

The groundmass is pilotaxitic, consisting of short green augite micro-lites, feldspar rods, and magnetite grains. No glass is present in the base.

The feldspar plates show an extinction angle of about 12° normal to 010, which indicates a soda-lime feldspar of an oligoclase or andesine composition.

The larger phenocrysts are olivine. They occur as rounded sections, usually much corroded by the magma, and show alteration to serpentine along the fractures. Crystal sections and anhedral grains of magnetite are common.

The above descriptions are made in the form of a report on the individual specimens in the collection, and no generalizations are attempted, because of the lack of sufficient representative material. Notes regarding the appearance and general structure of these volcanic islands are not at hand, consequently the contents of this paper are purely petrographical.